National Defense Center for Energy and Environment

Sustainable Contingency Bases
Reducing the Logistical and Environmental Footprint

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E2S2, New Orleans

May 11, 2011

DoD Executive Agent

Office of the
Assistant Secretary
of the Army
Installations, Energy and
Environment

The NDCEE is operated by: CTC *Concurrent Technologies Corporation*

Technology Transition – Supporting DoD Readiness, Sustainability, and the Warfighter

Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE	2. REPORT TYPE	3. DATES COVERED
11 MAY 2011		**00-00-2011 to 00-00-2011**

4. TITLE AND SUBTITLE	5a. CONTRACT NUMBER
Sustainable Contingency Bases Reducing the Logistical and Environmental Footprint	5b. GRANT NUMBER
	5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)	5d. PROJECT NUMBER
	5e. TASK NUMBER
	5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **National Defense Center for Energy and Environment (NDCEE),Concurrent Technologies Corporation,100 CTC Drive,Johnstown,PA,15904**	8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSOR/MONITOR'S ACRONYM(S)
	11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution unlimited

13. SUPPLEMENTARY NOTES
Presented at the NDIA Environment, Energy Security & Sustainability (E2S2) Symposium & Exhibition held 9-12 May 2011 in New Orleans, LA. U.S. Government or Federal Rights License

14. ABSTRACT

15. SUBJECT TERMS

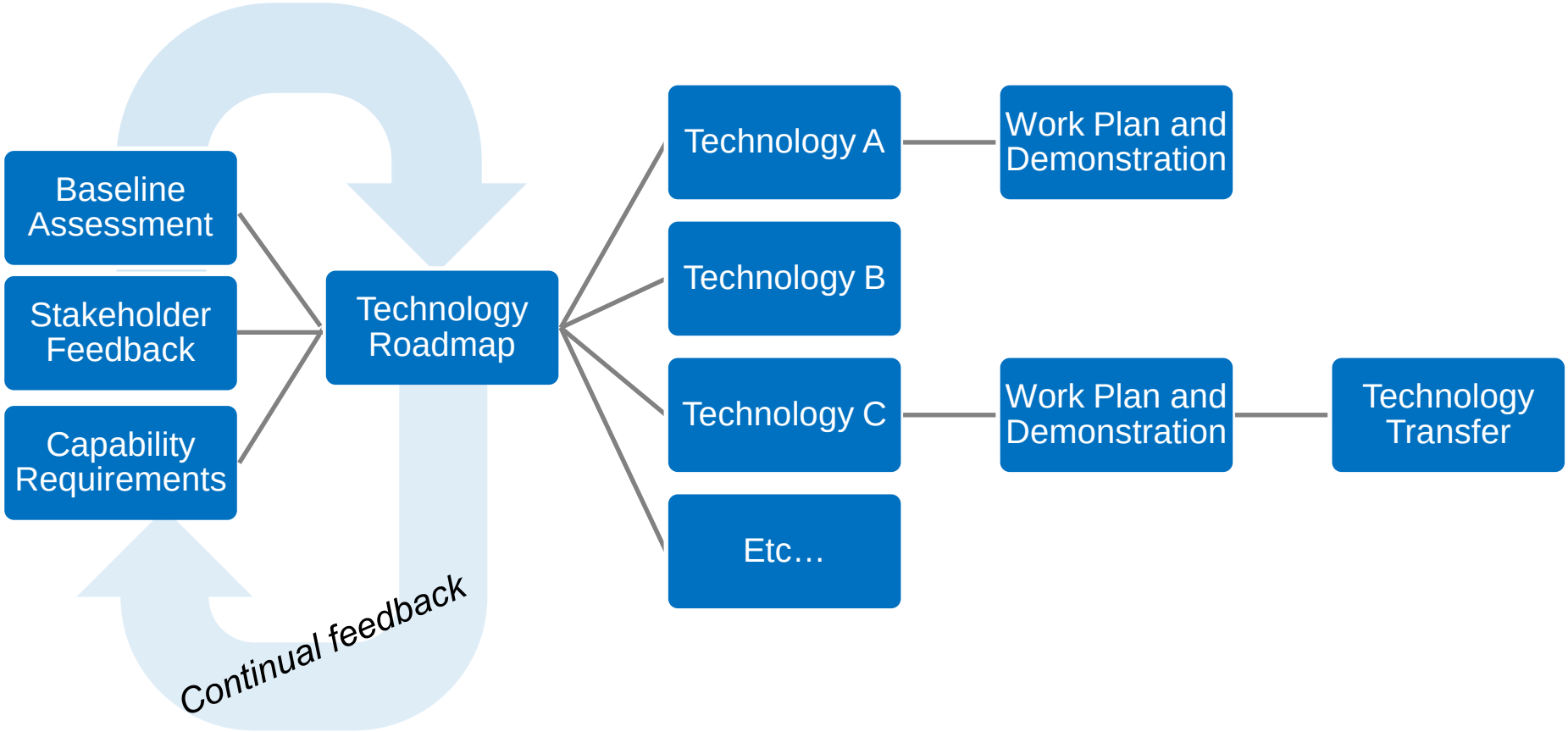
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT **unclassified**	b. ABSTRACT **unclassified**	c. THIS PAGE **unclassified**	**Same as Report (SAR)**	**28**	

Outline

- Approach
- Characterizing Contingency Bases
- System of Systems Framework
- Baseline Assessment
- Technology Roadmap
- Technology Demonstrations

Overall Approach

Energy, Water, Waste and Wastewater Focus



Characterizing Contingency Bases

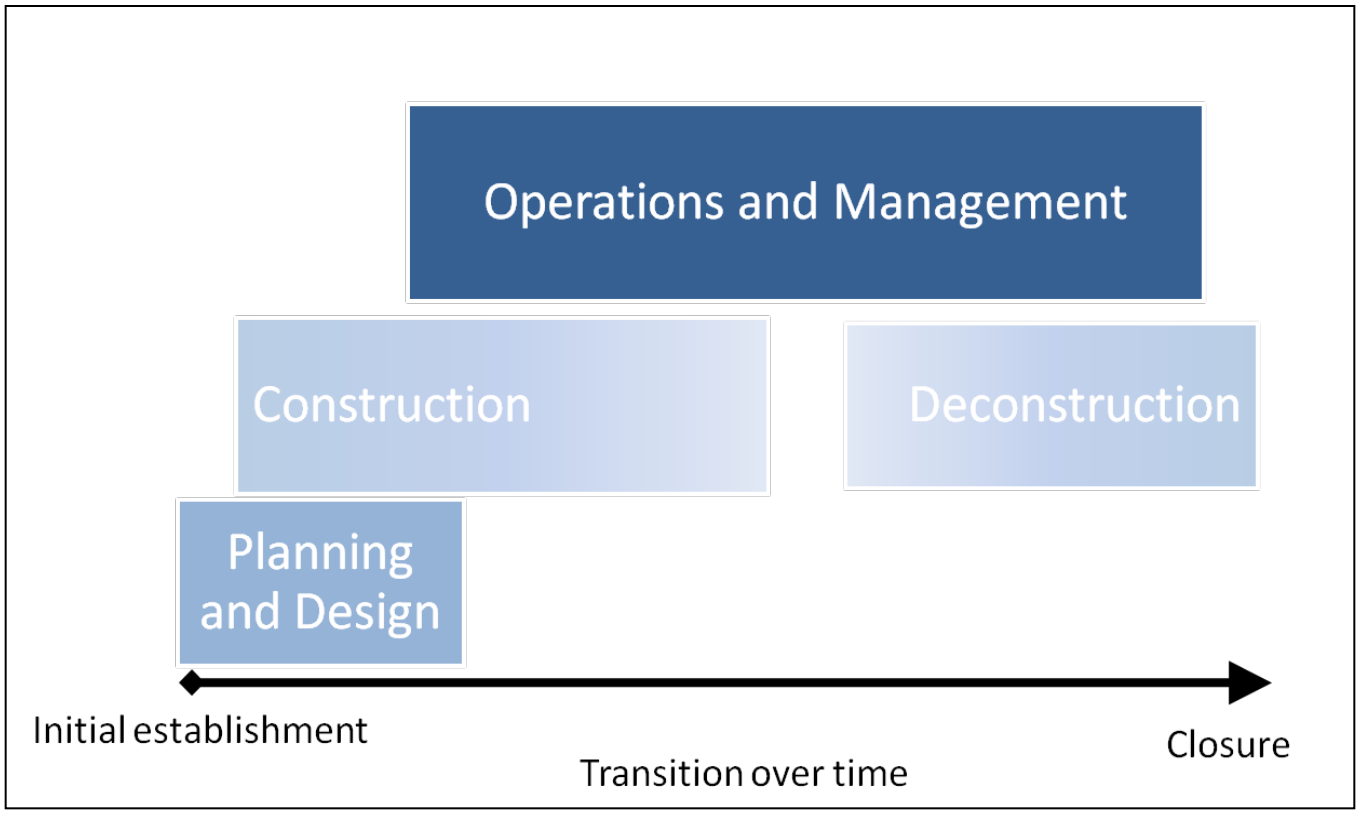
- Wide Range of Contexts
  - Each camp a unique combination of place, time, and mission
  - Lack of data to link important variables that affect camp environmental and energy footprint
    - Life cycle phase, size, age, function, location

Base Camp:
an evolving military facility that supports the military operations of a deployed unit and provides the necessary support and services for sustained operations.

Characterizing Bases by Life Cycle

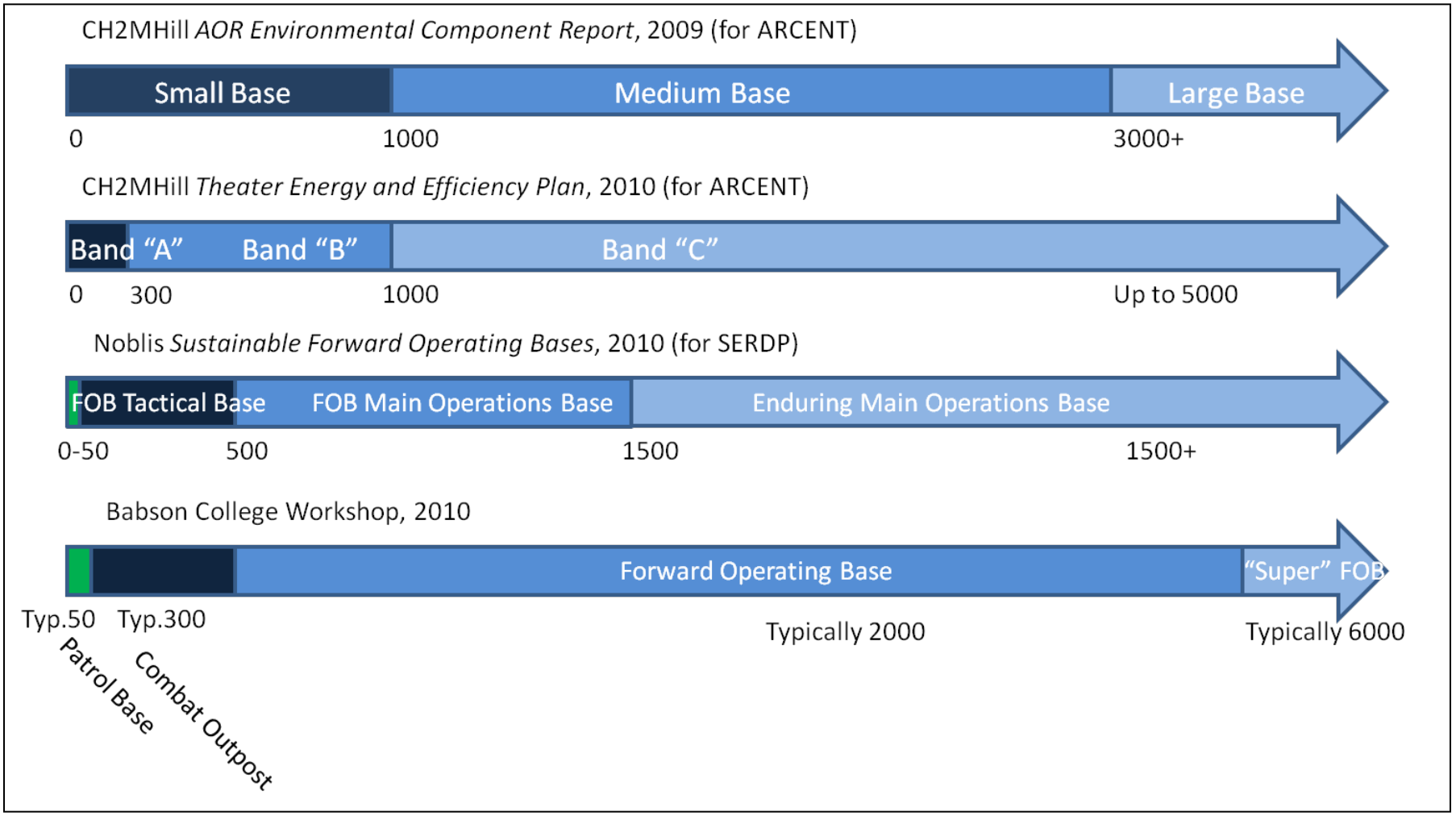
Source: Army Audit Agency, 2009

Characterizing Bases by Function



Source: TRADOC PAM 525-7-7

Characterizing Bases by Size



Characterizing Bases by Materiel Flow

Supplies
- Food
- Water
- Fuel/Power
- Personal Items
- Maintenance Materials
- Construction Materials
- Operations Materials

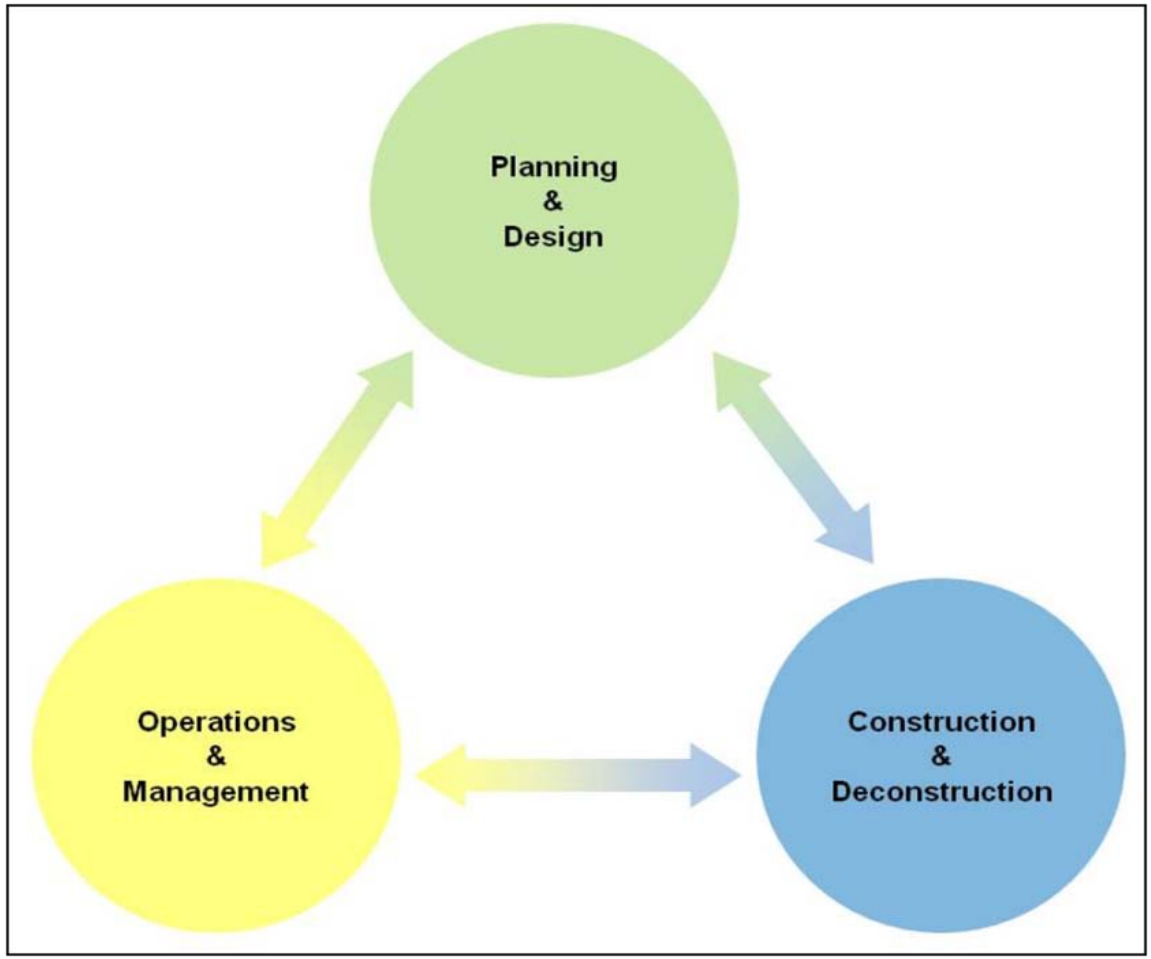
Waste
- Food Garbage
- Sanitary Water (Grey/Black)
- Wash Rack Water
- Solid Waste (Construction Debris, Packing Waste, Sludge)
- Hazardous Waste (Medical, Maintenance, Operational)
- Other Waste
- Heat

Source: Preston & Kinnevan, 2006

Applying a System of Systems Approach

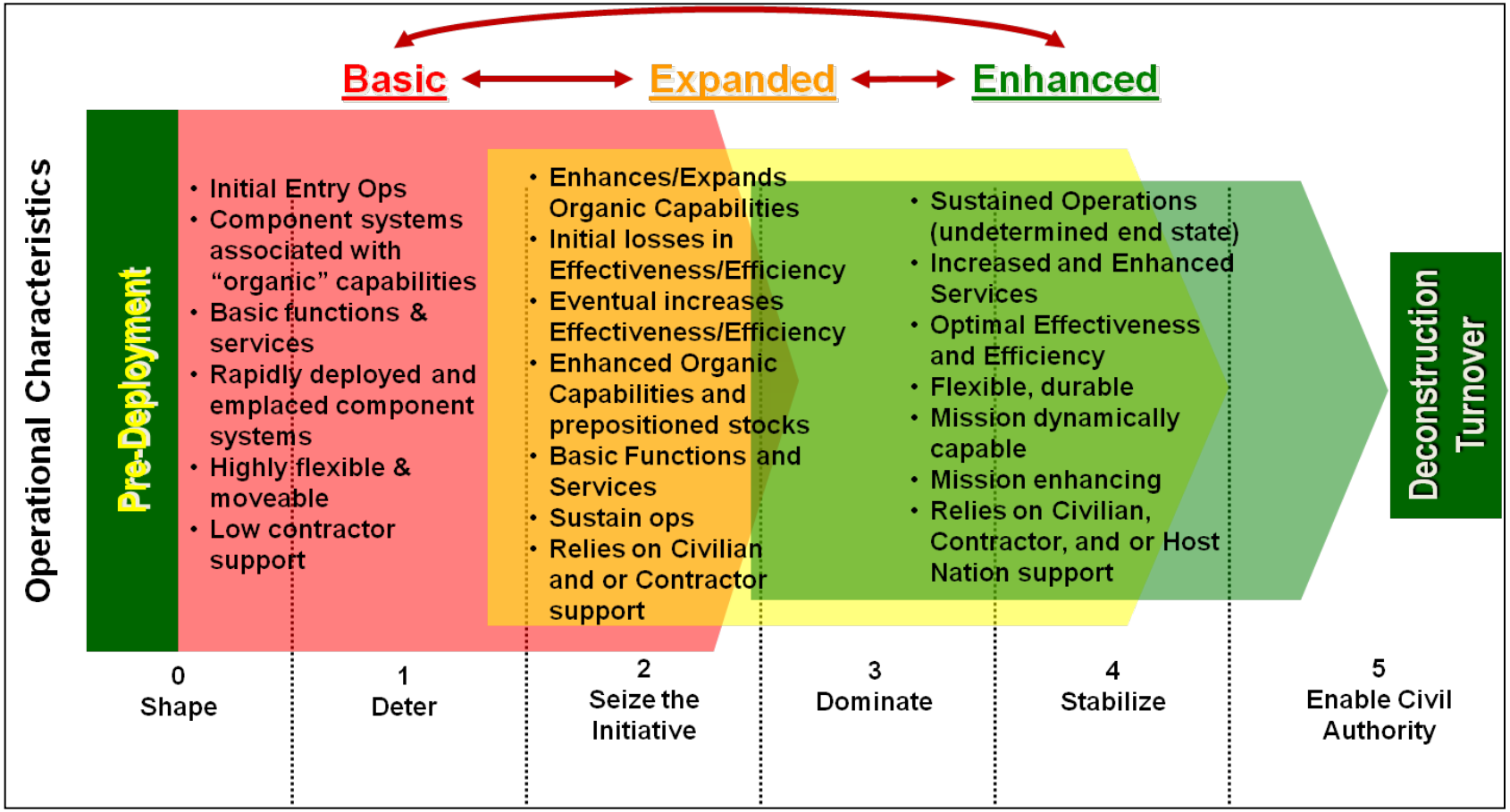
- System is greater than the sum of its parts
- Optimizing individual pieces will not necessarily achieve optimization for the system as a whole
  - Purpose-driven
  - Hierarchical
  - Interdependent
  - Interconnected
  - Complex
  - Dynamic

Characterizing Bases as a System of Interdependent Phases



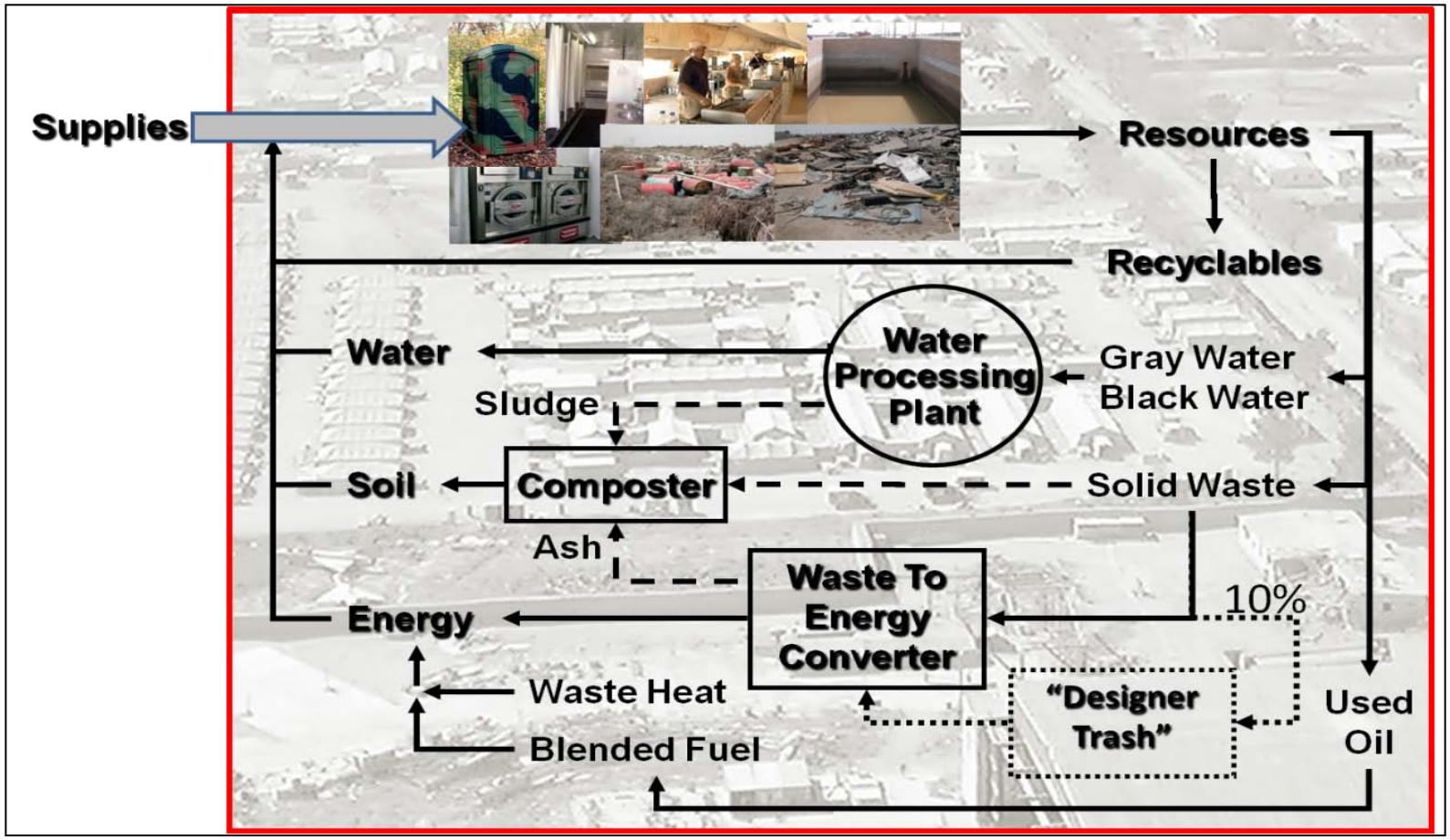
Source: TRADOC PAM 525-7-7

Characterizing Bases as Dynamic Relationships Changing over Time



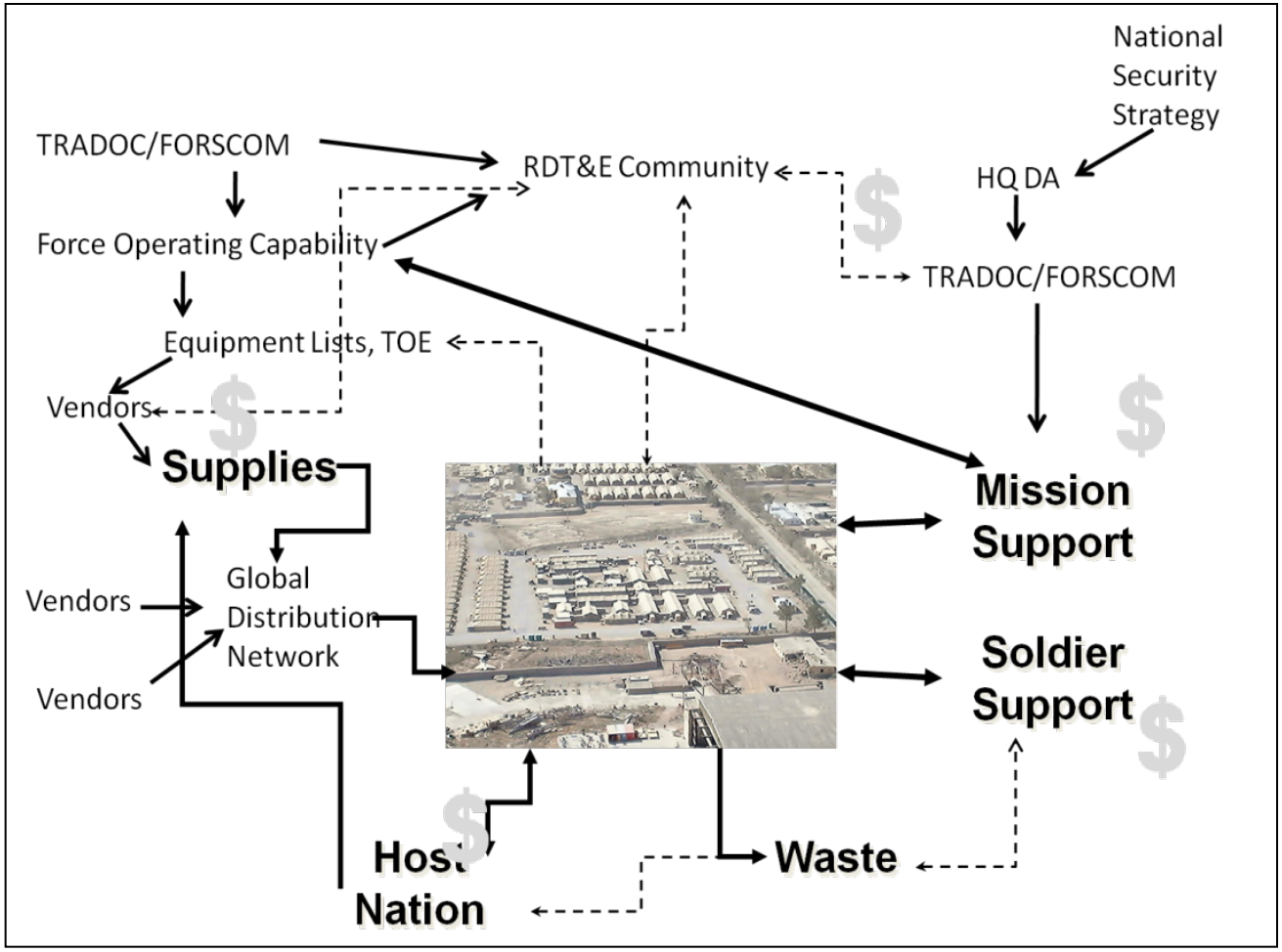
Source: Munroe, 2010

Characterizing Bases by Subsystem Relationships



Source: Preston & Kinnevan, 2006

Characterizing Bases as a System of Systems within the Army



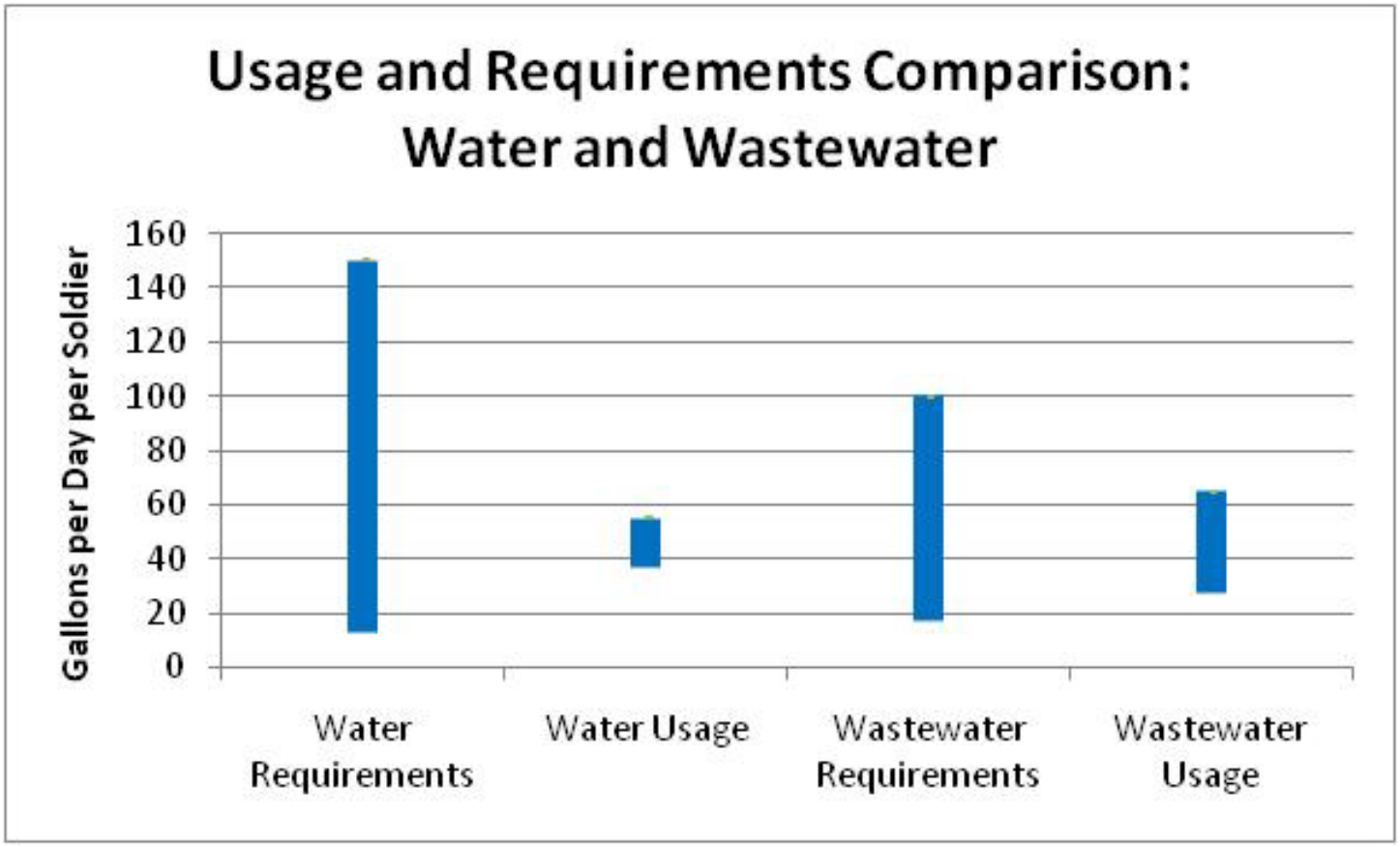
Baseline Assessment

- Requirements and usage data
  - Energy, power, water, wastewater, solid waste
  - Baseline technologies
- Literature search
- Data was not consistent
  - Values reported in baseline as ranges
  - Establishing required capabilities should also be done as ranges

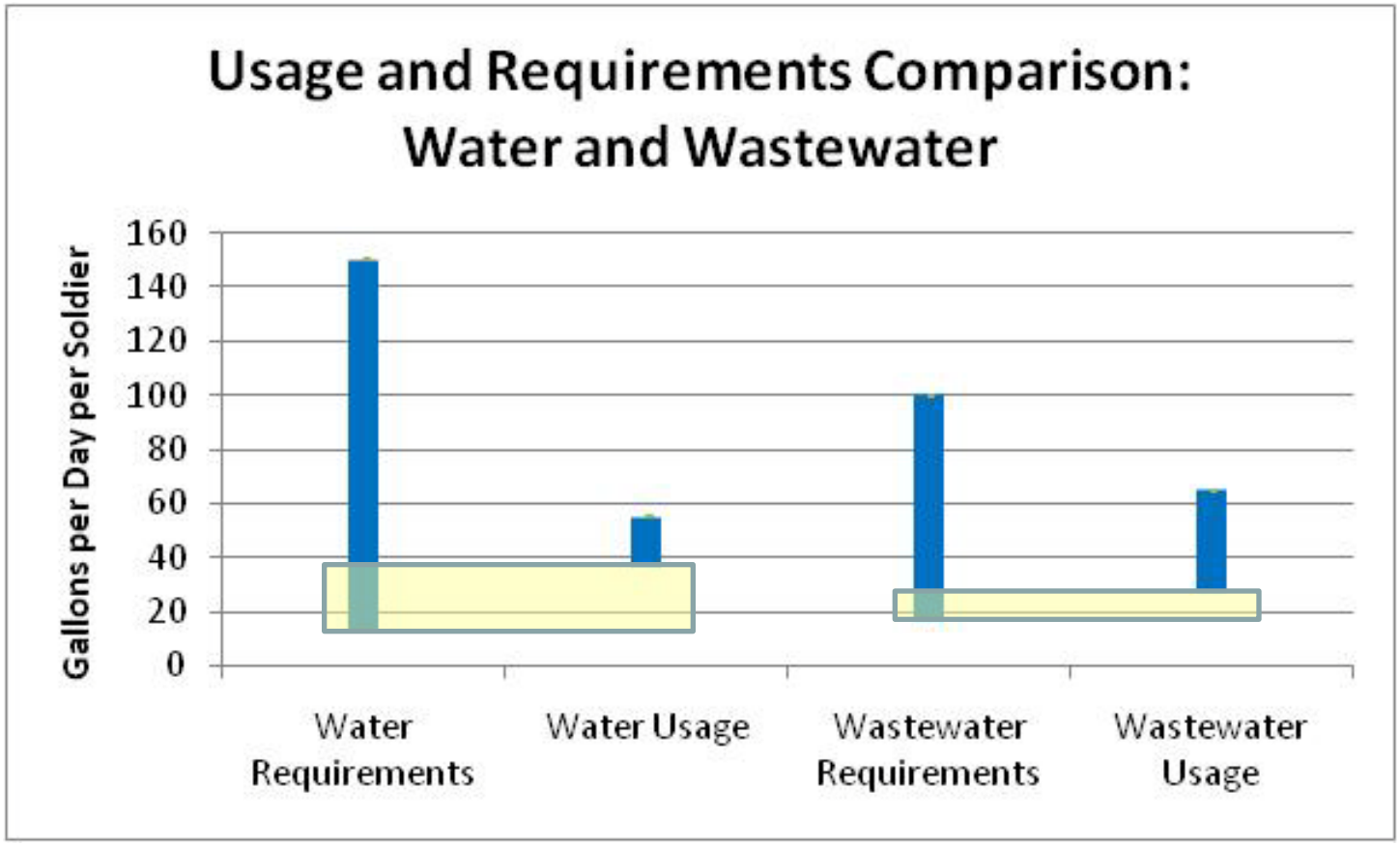
Baseline Assessment

Resource or Waste Product	Requirements Data		Usage Data		Units
	Low	High	Low	High	
Water	12.5	150	37	55	gallons/soldier/day
Wastewater	17.5	100	27	65	gallons/soldier/day
Solid Waste	8	12	4.1	18.2	pounds/soldier/day
Fuel	1.7	11	1	5.6	gallons/soldier/day
Power	0.32	3.5	0.5	0.8	kW/soldier

Baseline Assessment

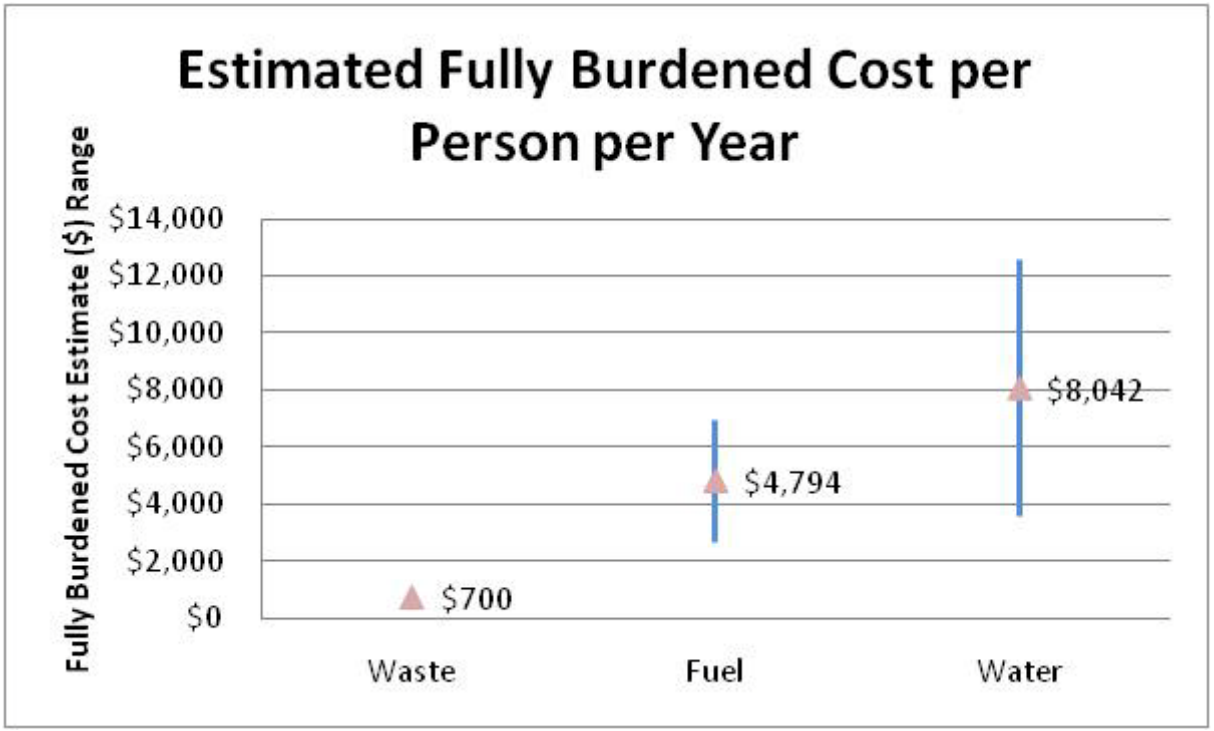


Baseline Assessment



Baseline Assessment

Based on Army Environmental Policy Institute studies in 2006 and 2011



Notes:
"Waste" estimate included solid waste, hazardous waste, wastewater, and medical waste and was determined with single Afghanistan case study of a large, enduring base in 2010.
Fuel and Water estimates had "high," "medium," and "low" scenarios and were based on a Brigade Combat Team of 3,999 soldiers deployed to Southwest Asia for cost factors in 2006.

Baseline Assessment

- Baseline Technology Summaries
  - Technologies Used to Supply Water
  - Wastewater Treatment Technologies
  - Solid Waste Technologies
  - Fuel Storage and Distribution Technologies
  - Technologies Relevant to Power Production, Distribution and Use
  - Energy Conservation Technologies

[1]

Baseline Assessment

Example of Technology Data Collected: Wastewater

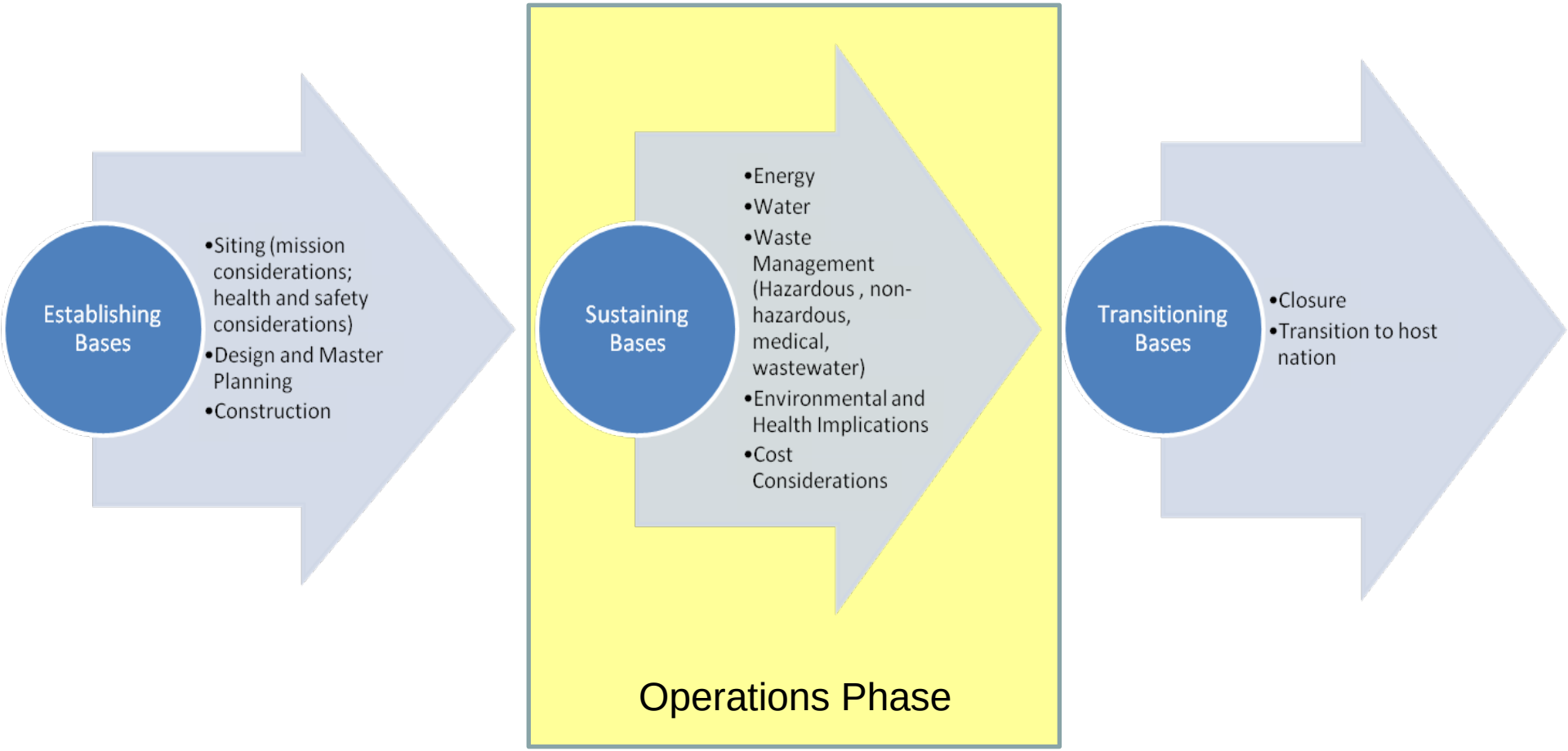
Technology Name	Description
Tanking and trucking offsite	Contracted support removes stored wastewater.
Septic system and leach fields	Allow for both black and gray water treatment and disposal and require a significant amount of land area. Also need distribution pipes, distribution boxes, septic tanks for solids, crushed rock, and geotextile fabric. Must be designed and operated properly. (Kandahar Air Field)
Lagoons	They provide a means of treating and disposing both black and gray water, while avoiding the need for contractors to remove waste to landfills (assuming that the overall system integrates flush toilets to dispose of solid wastes). Must be designed and operated properly.
Wastewater Treatment Package Plant	Used at large, semi-permanent bases. Some small, portable or semiportable systems are available from contractors.
Shower Water Reuse System (SWRS)	Used in Force Provider: can recycle 9000 gallons per day (75% of water used). Uses reverse osmosis, activated carbon, UV light sterilization and calcium hypochlorite
Burnout latrines	Typical for small, short-term camps. Burn out latrines are often the first method used for field sanitation. They can be constructed by engineer or other military personnel and use vehicle fuel mixed with the waste in order to burn it.
Pit latrines	Similar concept to burnout latrines but waste is buried.
Portalettes/Porta-johns	Generally require contractors for servicing and, unlike burn out latrines, the waste must be moved to a sanitary landfill site. May generate “blue-water” or waste with chemical additives.

Technology Roadmap Folder Structure

Technology Roadmap Initial Focus Areas

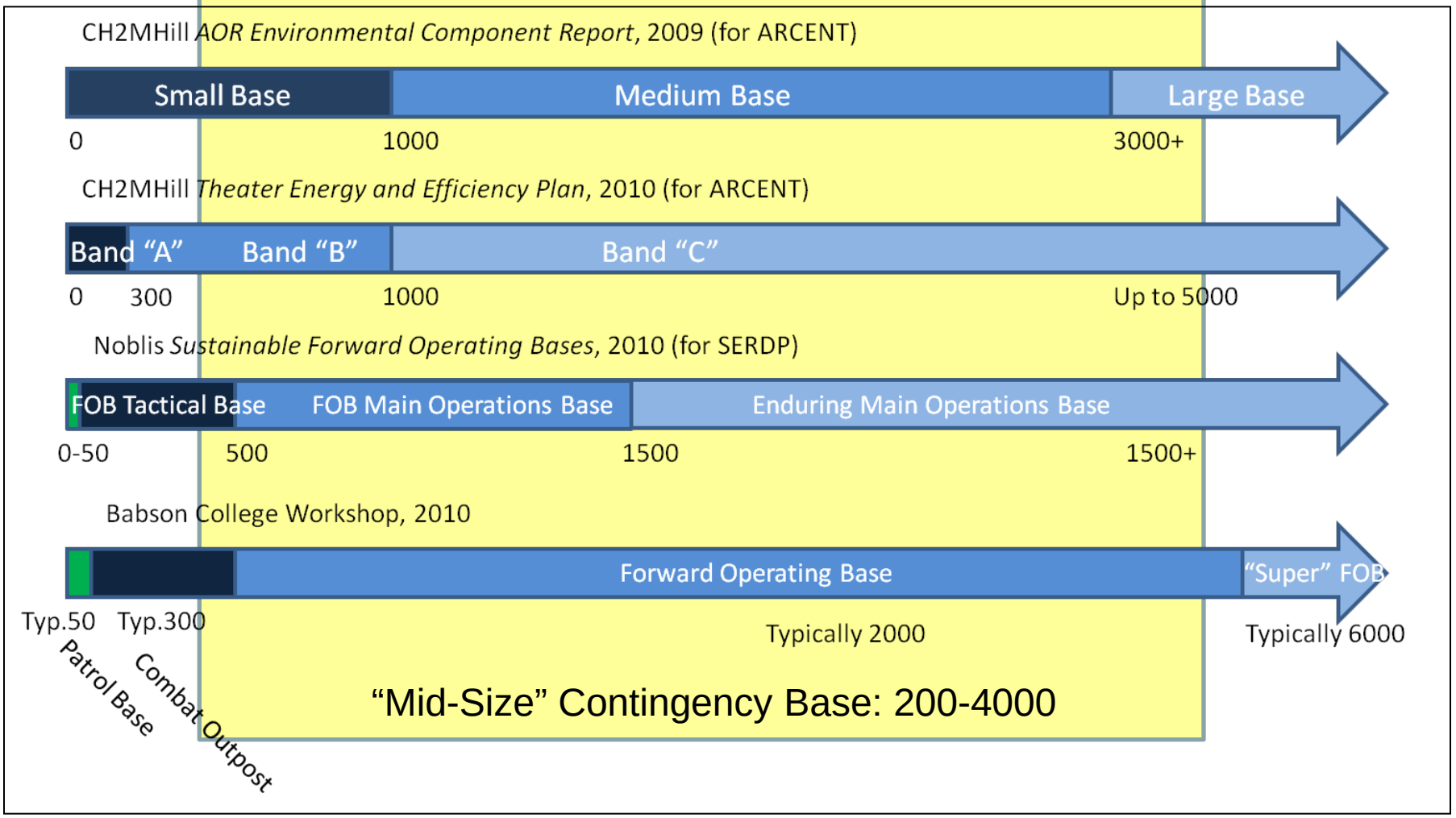
- Operations Phase of Contingency Base
  - Immediate impact for *existing* bases
- 'Mid-Size' Contingency Base: 200-4000 Soldiers
  - Greatest potential for technology-based solutions that are transferable, deployable and financially feasible
    - Command outposts – highest cost & soldier-based technologies; addressed by PMFSS & Force Provider
    - Super FOBs – major infrastructure projects
- Water, Wastewater, Solid Waste
  - Water = larger portion of footprint in # convoys and costs
  - Multiple existing operational energy efforts
  - Greatest *immediate* impact in power & energy not through new technologies
    - Improving efficiency of existing technologies
    - Changing behavior
    - Ongoing implementation of readily available solutions

Technology Roadmap Initial Focus Areas



Source: Army Audit Agency, 2009

Technology Roadmap Initial Focus Areas



Recommendations

Short Term

- Update Baseline Assessment and Roadmap as additional information becomes available
- Set contingency base parameters of interest
- Develop and prioritize goals associated with the contingency base environmental and energy footprint
- Participate in contingency base-oriented communities of practice
  - Situational awareness

Long Term

- Detailed case studies
  - Track the full logistics and environmental footprint
    - Fully burdened costs
    - “Bill-payers”
    - Distinct sizes, functions, locations and maturity levels

Priorities Lead to Technology Gaps

Potential Goals/Priorities	Implied Technology Gap
Reduce the overall operating costs for contingency bases	Improved efficiency in electrical generators Reduced energy demand by ECUs Onsite energy generation and storage
Reduce the number of supply convoys for contingency bases	Improved efficiency in electrical generators Reduced energy demand by ECUs Onsite energy generation and storage Onsite water purification
Reduce the negative environmental impacts to the host nation from contingency base operations	Onsite reduction of solid waste volume Improved efficiency in incineration (higher temperatures for more complete combustion) Onsite reduction of hazardous attributes of waste Onsite wastewater treatment

Priorities Lead to Technology Gaps

Potential Goals/Priorities	Implied Technology Gap
Reduce the negative impacts to soldier health and safety from contingency base operations	Improved efficiency in incineration (higher temperatures for more complete combustion) Onsite reduction of hazardous attributes of waste Onsite wastewater treatment
Reduce environmental and energy footprint throughout the life cycle of materiel use at contingency base	Elimination of waste in materiel life cycle (packaging, re-use) Onsite wastewater treatment and re-use through closed-loop systems Highly efficient living quarters that generate and store energy in micro-grids that provide lighting, temperature control, and power for individual electronics

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This work was funded through the Office of the Assistant Secretary of the Army Installations, Energy and Environment and conducted under contract W91ZLK-10-D-0005 *Task 0720. The views, opinions, and/or findings contained in this paper are those of the author(s) and should not be construed as an official Department of the Army position, policy, or decision unless so designated by other official documentation.*